Supplementary information

Investigating aquatic biodegradation and changes in the properties of pristine and UV-irradiated microplastics from conventional and biodegradable agricultural plastics

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Table S1. LA-ICP-MS measurement parameters.

Nexion500 (PerkinElmer, USA)		**ImageGEO193 (ESL, USA)**	
Plasma Power (W)	1600	Laser Fluence (J/cm2)	3
Aux. Gas flow (L/min)	1.2	Repetition Rate (Hz)	80
Plasma gas flow (L/min)	16	Scan Speed (µm/s)	176
KED gas flow (ml/min)	2.5	Spot size (µm)	10x10
Detected Isotopes	13C, 208Pb, 56Fe, 39K, 24Mg, 23Na, 27Al, 60Ni, 68Zn, 47Ti	Chamber He flow (L/min)	0.8
Dwell time per isotope (ms)	5		

Table S2. Liquid ICP-MS measurement parameters.

iCAP TQ ICP-MS	
Plasma Power (W)	1550
Nebulizer gas flow (L/min)	1
Aux. gas flow (L/min)	0.8
Plasma gas flow (L/min)	14
Measurement Mode	KED
KED gas flow (ml/min)	3.5
Detected Isotopes	^{23}Na, ^{24}Mg, ^{27}Al, ^{39}K, ^{47}Ti, ^{56}Fe, ^{60}Ni, ^{66}Zn, ^{208}Pb
Dwell time per isotope (ms)	10

Table S3. *p* values of statistical analysis of biodegradability test; comparisons for each sampling time between PE and UV-PE treatments and PBAT and UV-PBAT treatments (two-sample t-test).

Sampling time (day)	p (/)	
	PE and UV-PE	PBAT and UV-PBAT
0.69	0.1421	0.4658
0.90	0.2168	0.4659
3.71	0.0752	0.3973
3.95	0.0546	0.3891
4.71	0.1422	0.4438
5.00	0.1048	0.4027
5.66	0.0746	0.3788
7.69	0.0724	0.3672
10.82	0.2012	0.3136
11.71	0.2311	0.3417
12.71	0.1590	0.2509
13.75	0.2688	0.2378
14.83	0.2345	0.1986
17.68	0.2961	0.0649
18.75	0.2638	0.0504
19.81	0.2633	**0.0352**
20.75	0.2523	**0.0262**
21.77	0.3538	**0.0201**
24.76	0.3231	**0.0116**
25.76	0.5407	**0.0114**
26.76	0.6015	**0.0120**
27.81	0.4823	**0.0138**
28.66	0.4391	**0.0166**

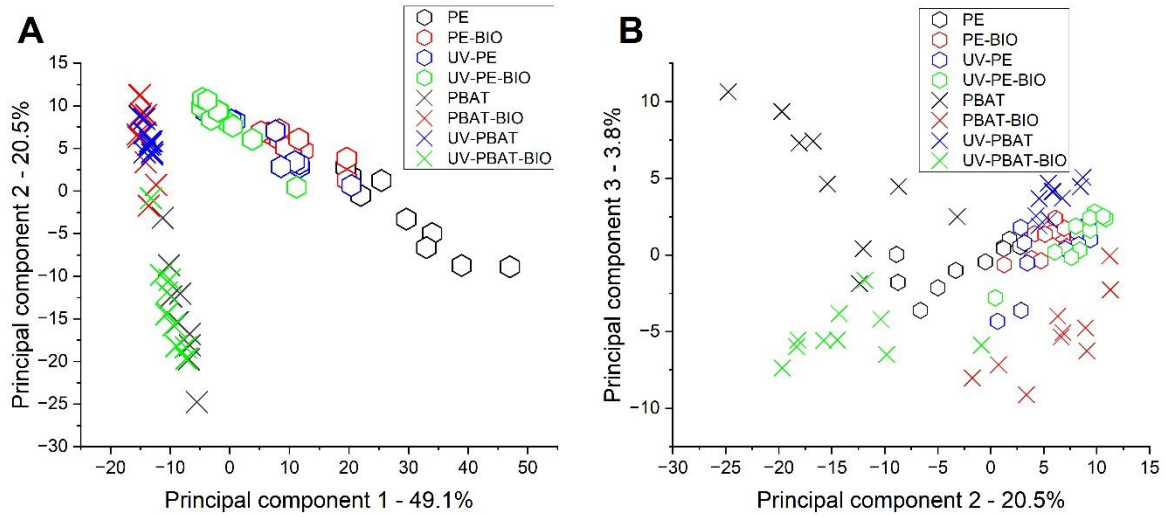

Figure S1. PCA plot of all Raman background-corrected spectra: A) PC1 and PC2 score plots and B) PC2 and PC3 score plots. PE is marked with a hexagon symbol and PBAT with a cross symbol. Different ageing treatments are marked with different colours.

Table S4. Content of selected metals (µg/g) in investigated microplastics.

Sample/ element	^{23}Na	^{24}Mg	^{27}Al	^{39}K	^{47}Ti	^{56}Fe	^{60}Ni	^{66}Zn	^{208}Pb
PE	27.04	87.43	383.84	73.61	4.43	26.54	3.06	62.13	<LOD
PBAT	55.79	341.65	36.95	197.02	448.86	35.18	2.08	9.82	0.19

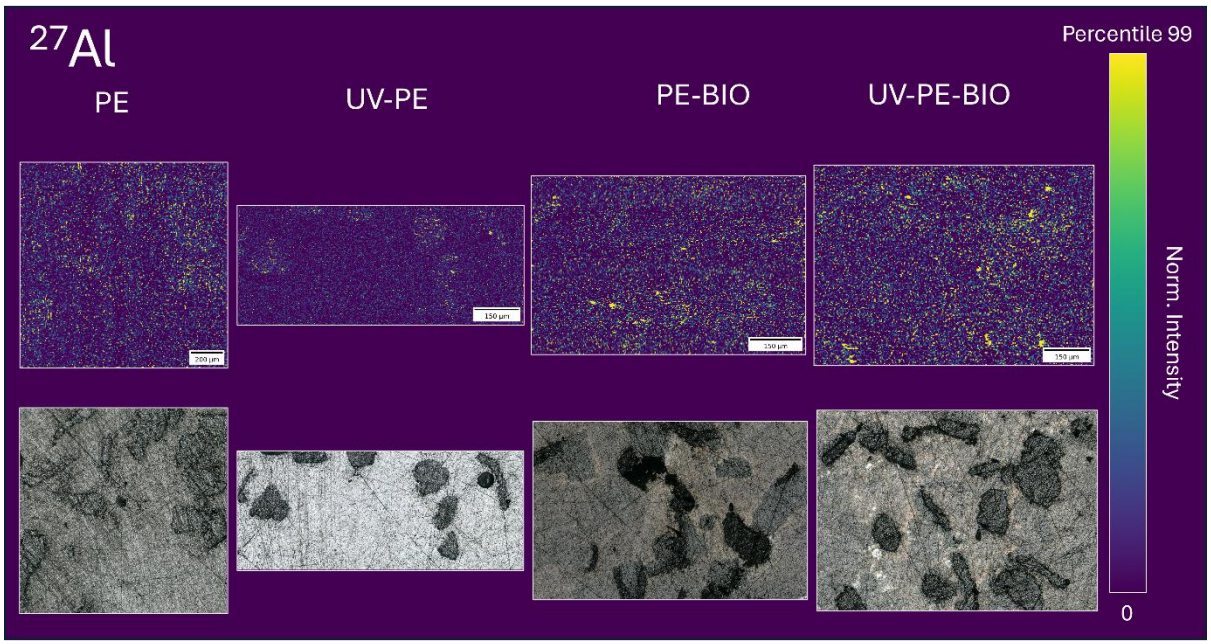

Figure S2. LA-ICP-MS analysis of Al in pristine PE, UV irradiated (UV-PE) and after biodegradation (PE-BIO, UV-PE-BIO).

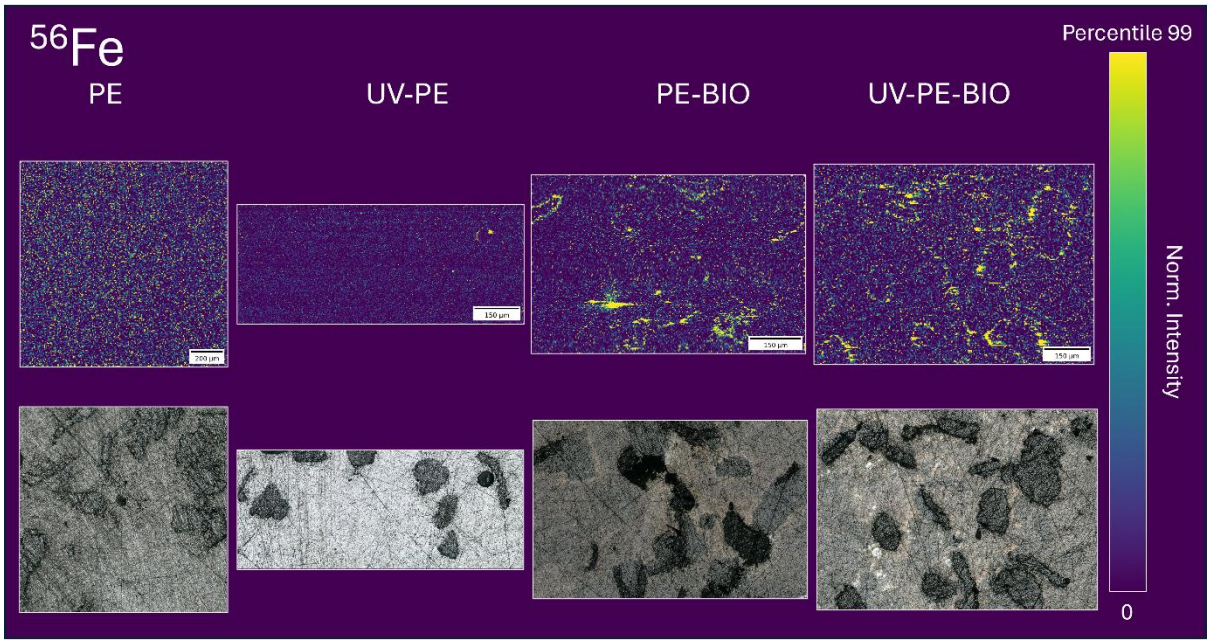

Figure S3. LA-ICP-MS analysis of Fe in pristine PE, UV irradiated (UV-PE) and after biodegradation (PE-BIO, UV-PE-BIO).

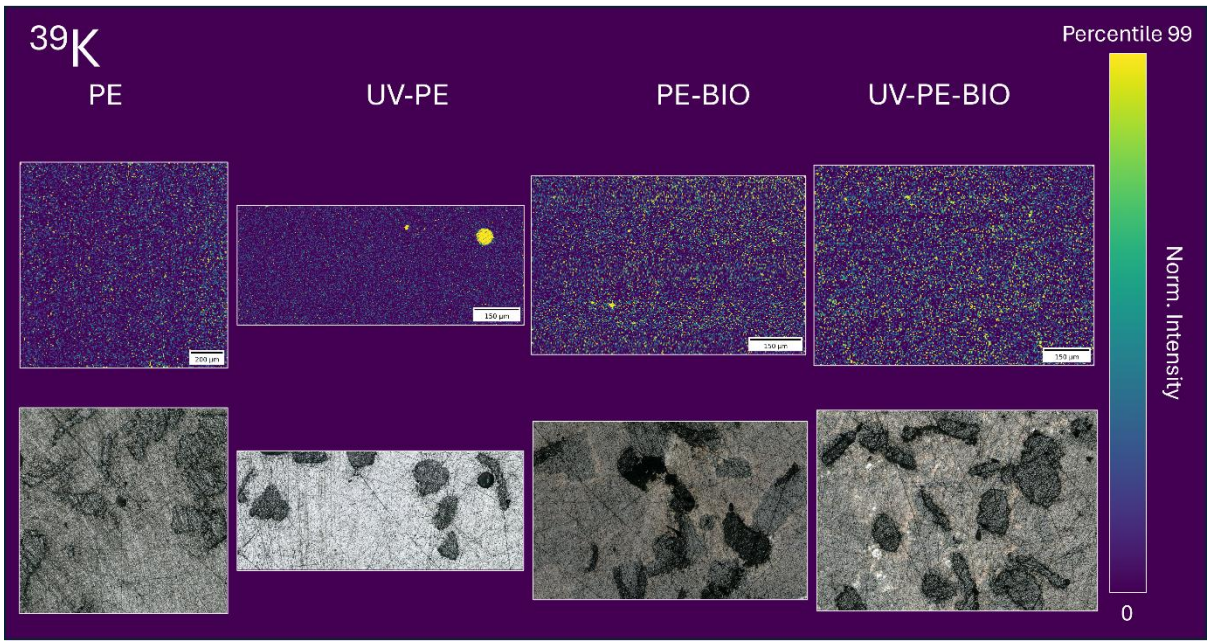

Figure S4. LA-ICP-MS analysis of K in pristine PE, UV irradiated (UV-PE) and after biodegradation (PE-BIO, UV-PE-BIO).

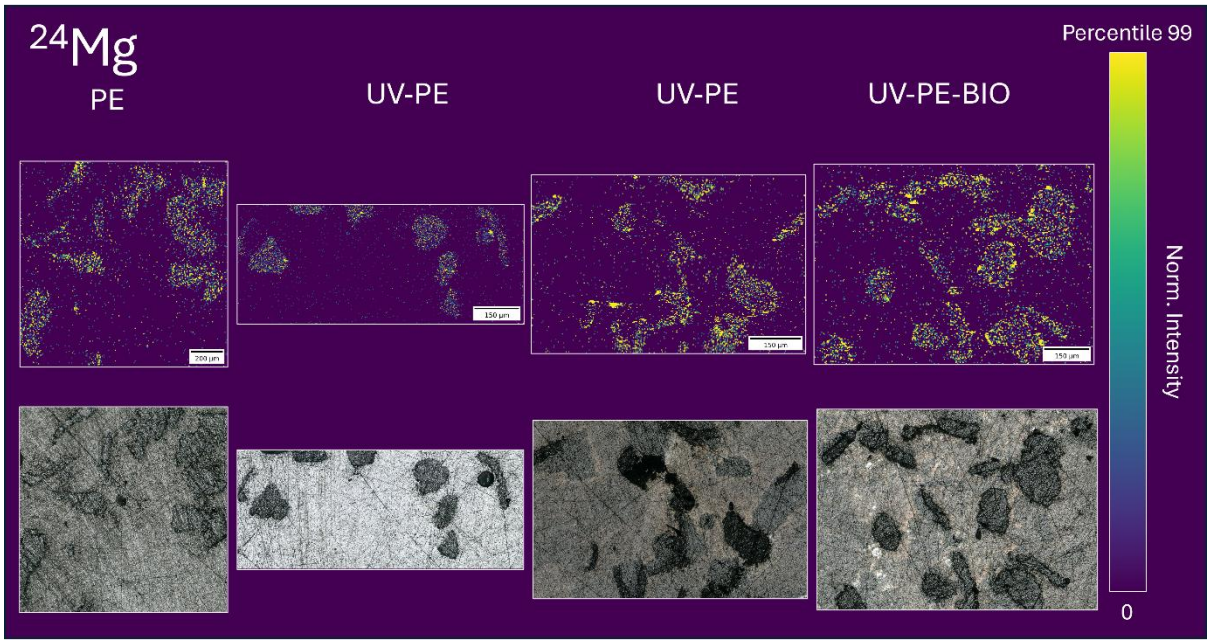

Figure S5. LA-ICP-MS analysis of Mg in pristine PE, UV irradiated (UV-PE) and after biodegradation (PE-BIO, UV-PE-BIO).

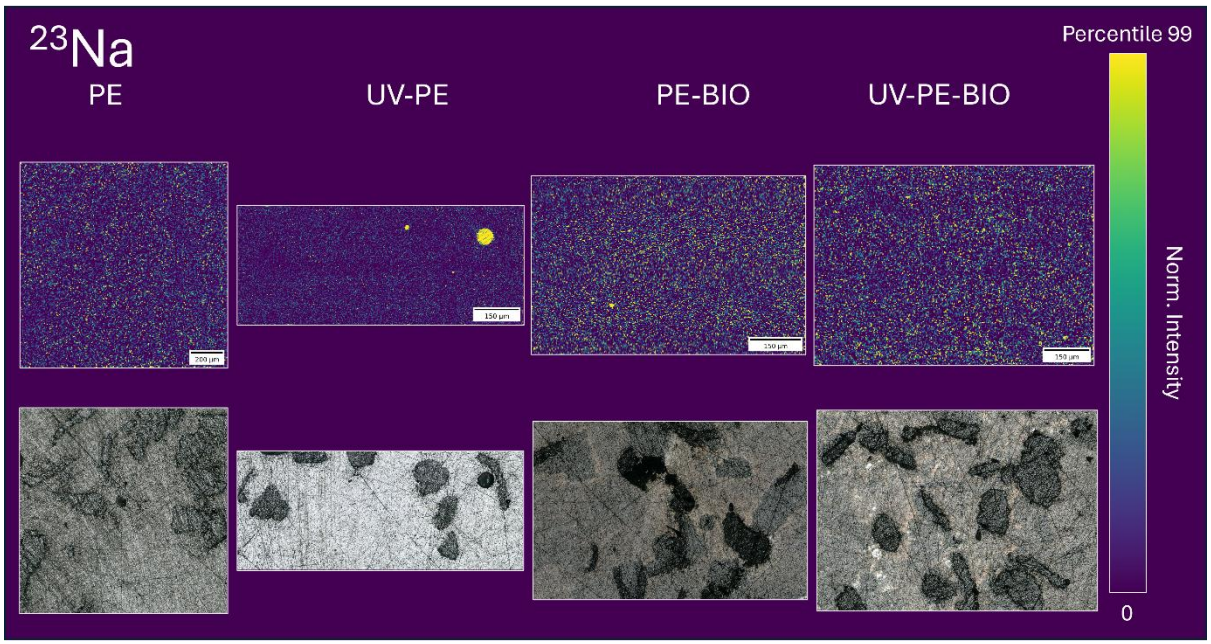

Figure S6. LA-ICP-MS analysis of Na in pristine PE, UV irradiated (UV-PE) and after biodegradation (PE-BIO, UV-PE-BIO).

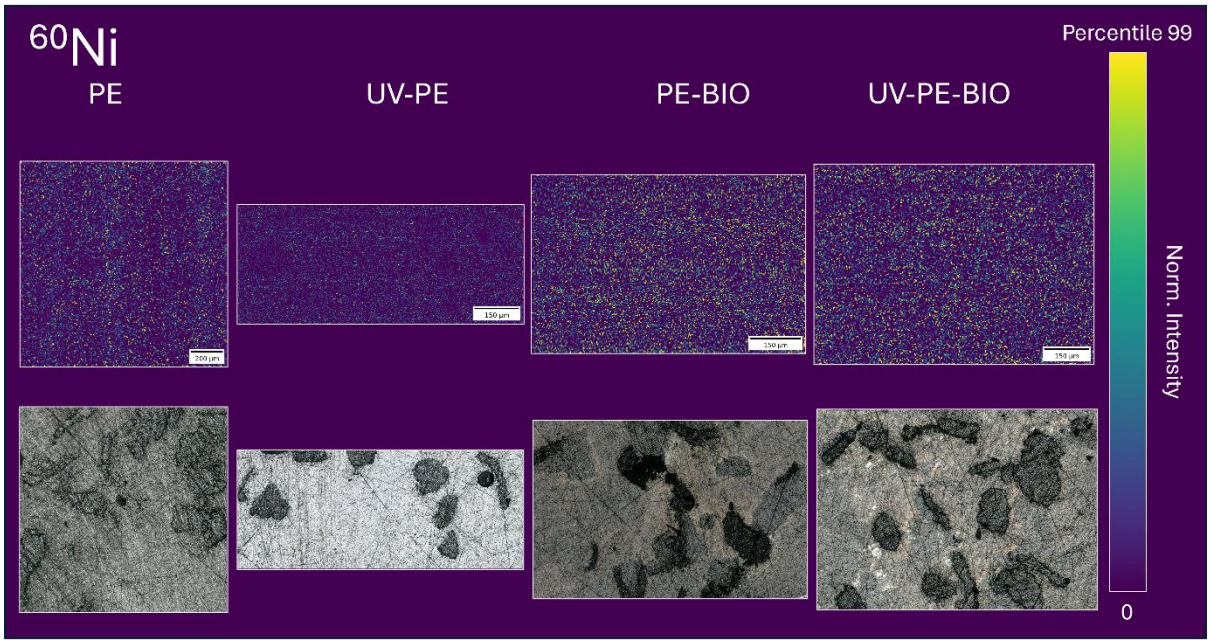

Figure S7. LA-ICP-MS analysis of Ni in pristine PE, UV irradiated (UV-PE) and after biodegradation (PE-BIO, UV-PE-BIO).

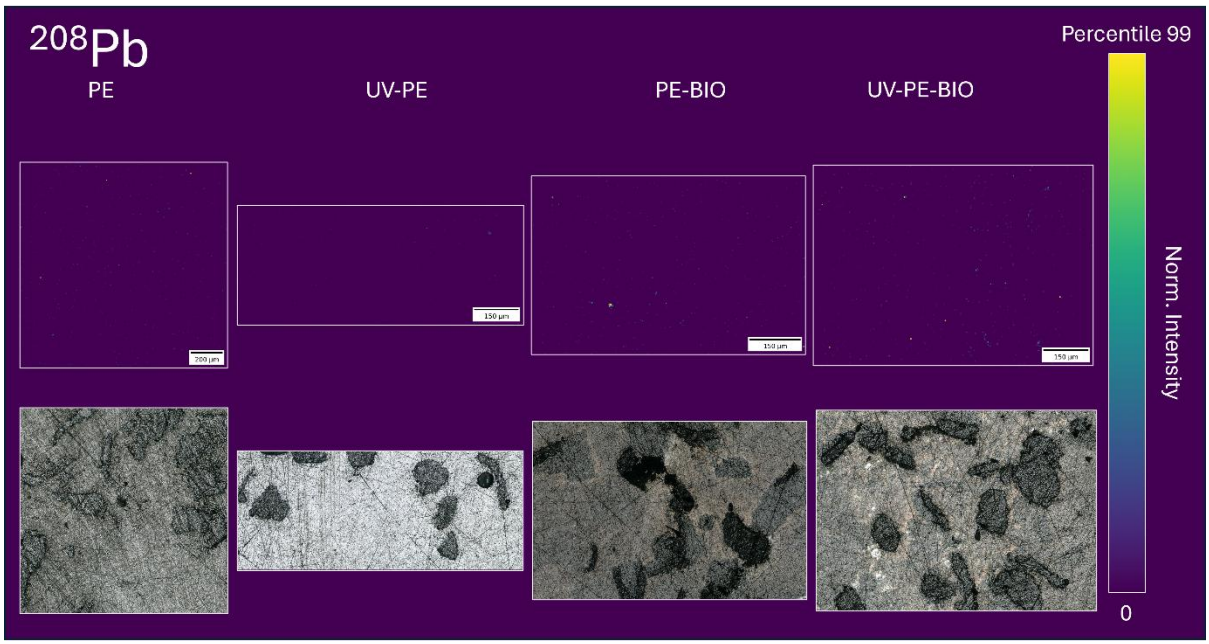

Figure S8. LA-ICP-MS analysis of Pb in pristine PE, UV irradiated (UV-PE) and after biodegradation (PE-BIO, UV-PE-BIO).

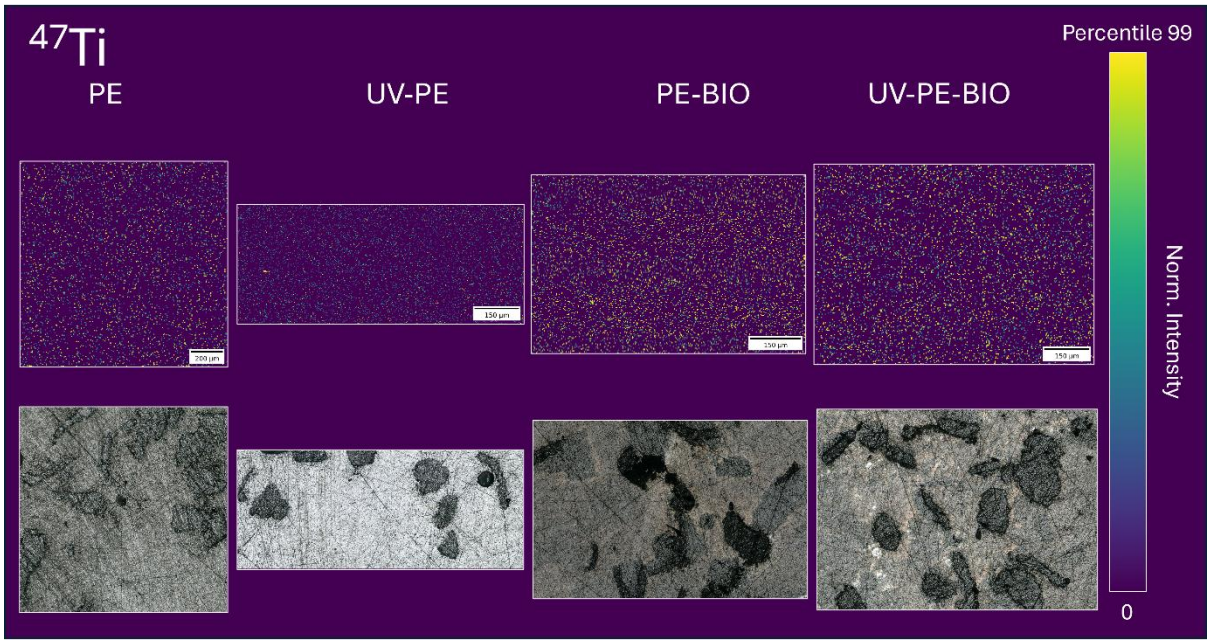

Figure S9. LA-ICP-MS analysis of Ti in pristine PE, UV irradiated (UV-PE) and after biodegradation (PE-BIO, UV-PE-BIO).

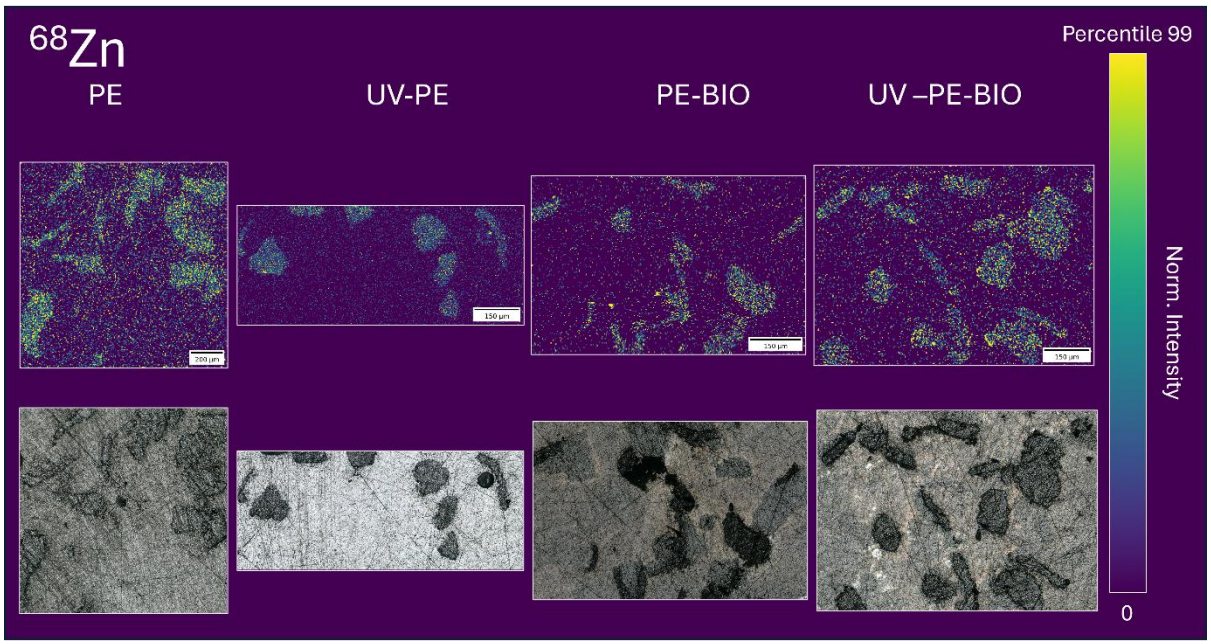

Figure S10. LA-ICP-MS analysis of Zn in pristine PE, UV irradiated (UV-PE) and after biodegradation (PE-BIO, UV-PE-BIO).

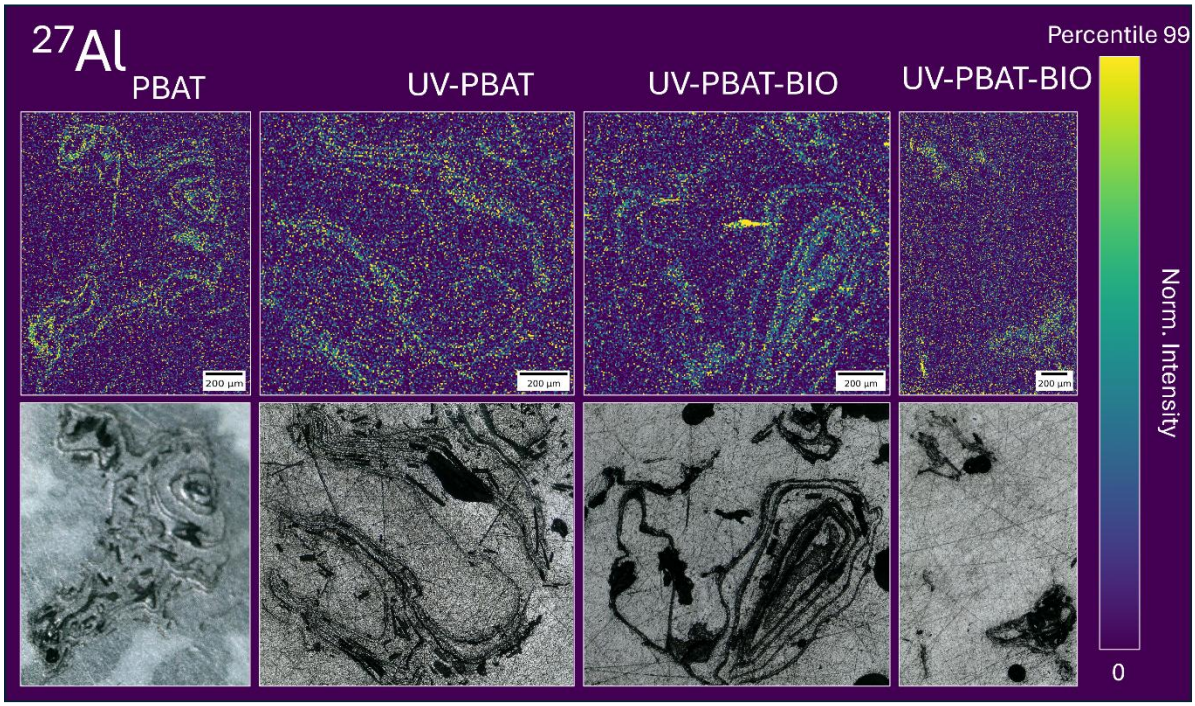

Figure S11. LA-ICP-MS analysis of Al in pristine PBAT, UV irradiated (UV-PBAT) and after biodegradation (PBAT-BIO, UV-PBAT-BIO).

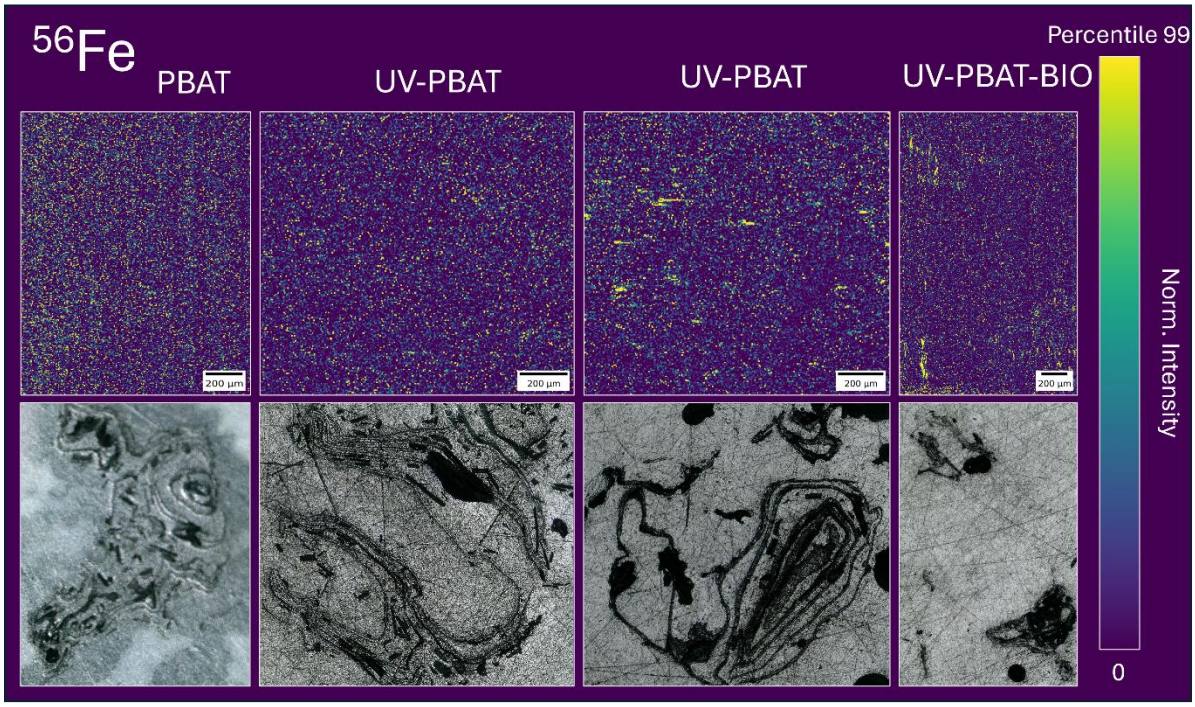

Figure S12. LA-ICP-MS analysis of Fe in pristine PBAT, UV irradiated (UV-PBAT) and after biodegradation (PBAT-BIO, UV-PBAT-BIO).

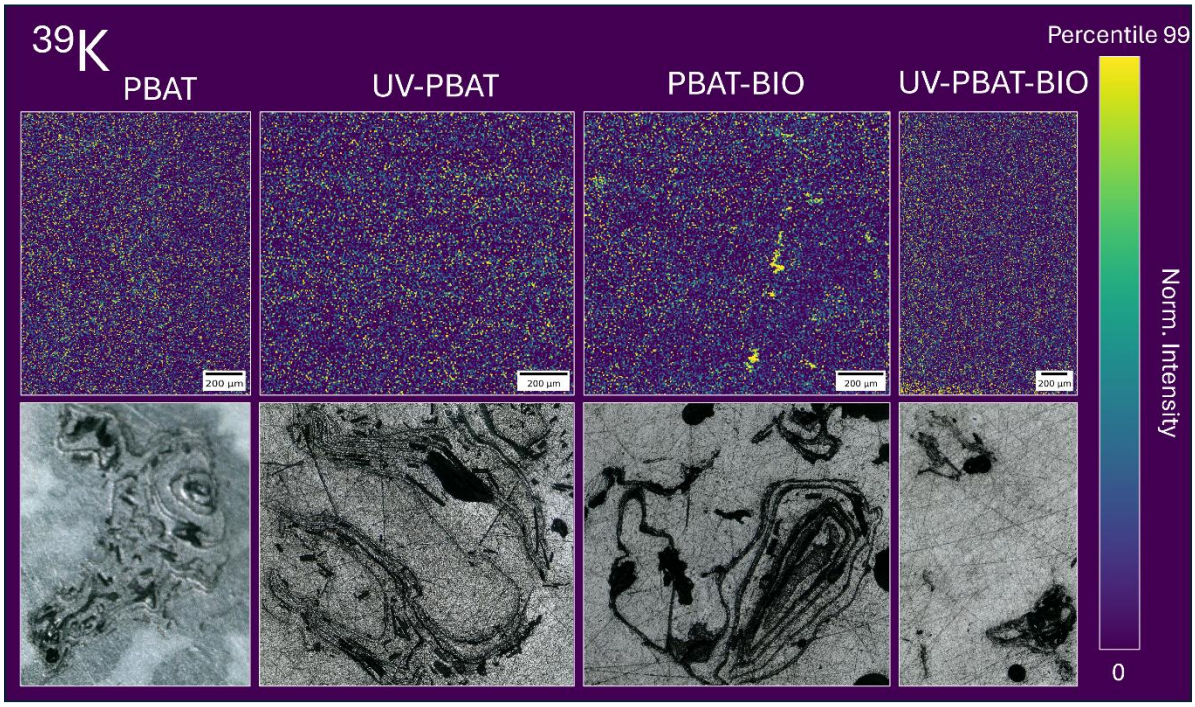

Figure S13. LA-ICP-MS analysis of K in pristine PBAT, UV irradiated (UV-PBAT) and after biodegradation (PBAT-BIO, UV-PBAT-BIO).

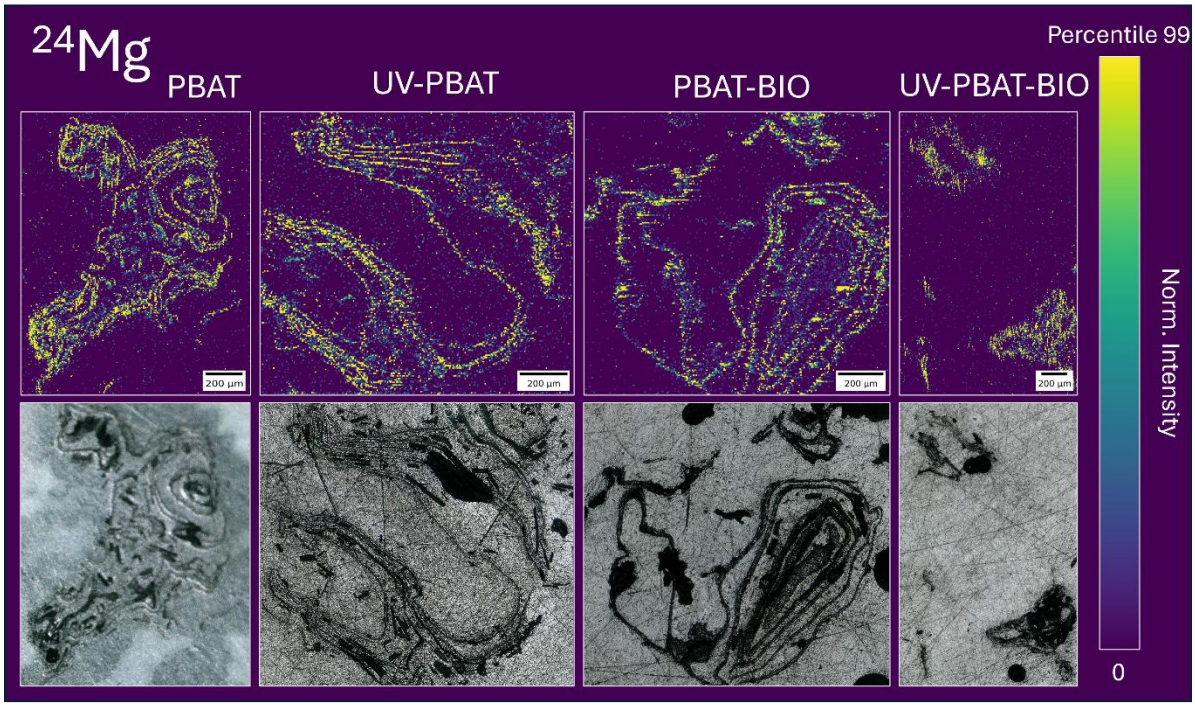

Figure S14. LA-ICP-MS analysis of Mg in pristine PBAT, UV irradiated (UV-PBAT) and after biodegradation (PBAT-BIO, UV-PBAT-BIO).

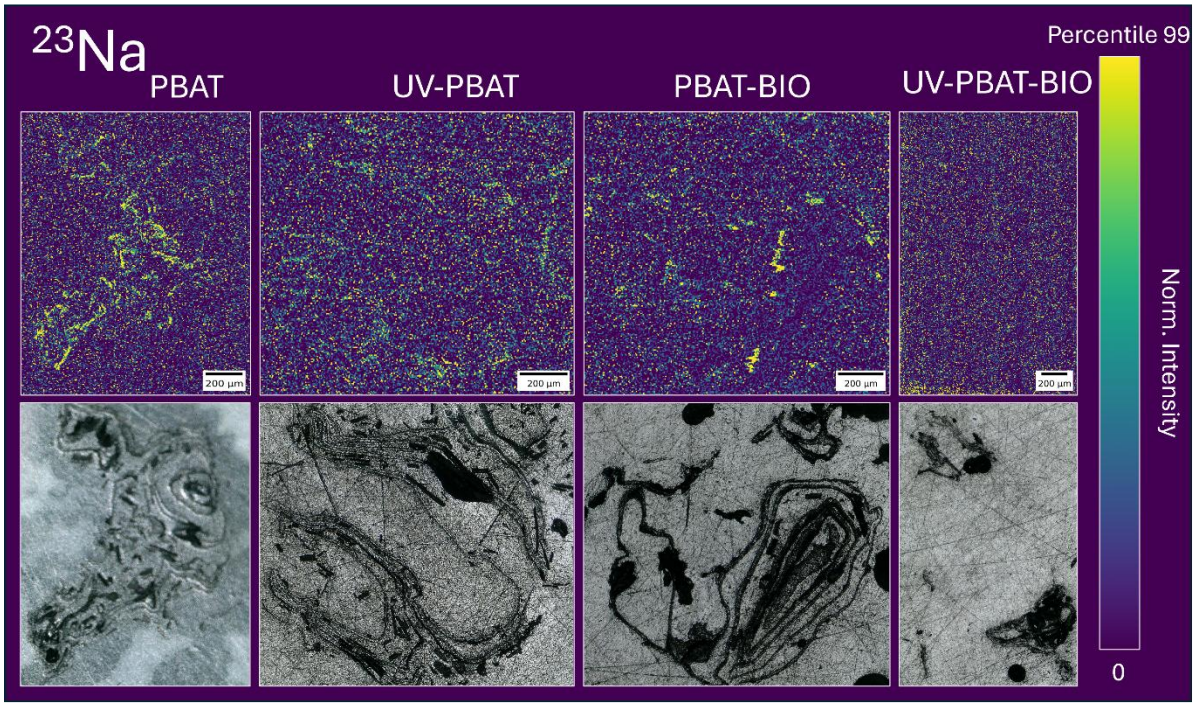

Figure S15. LA-ICP-MS analysis of Na in pristine PBAT, UV irradiated (UV-PBAT) and after biodegradation (PBAT-BIO, UV-PBAT-BIO).

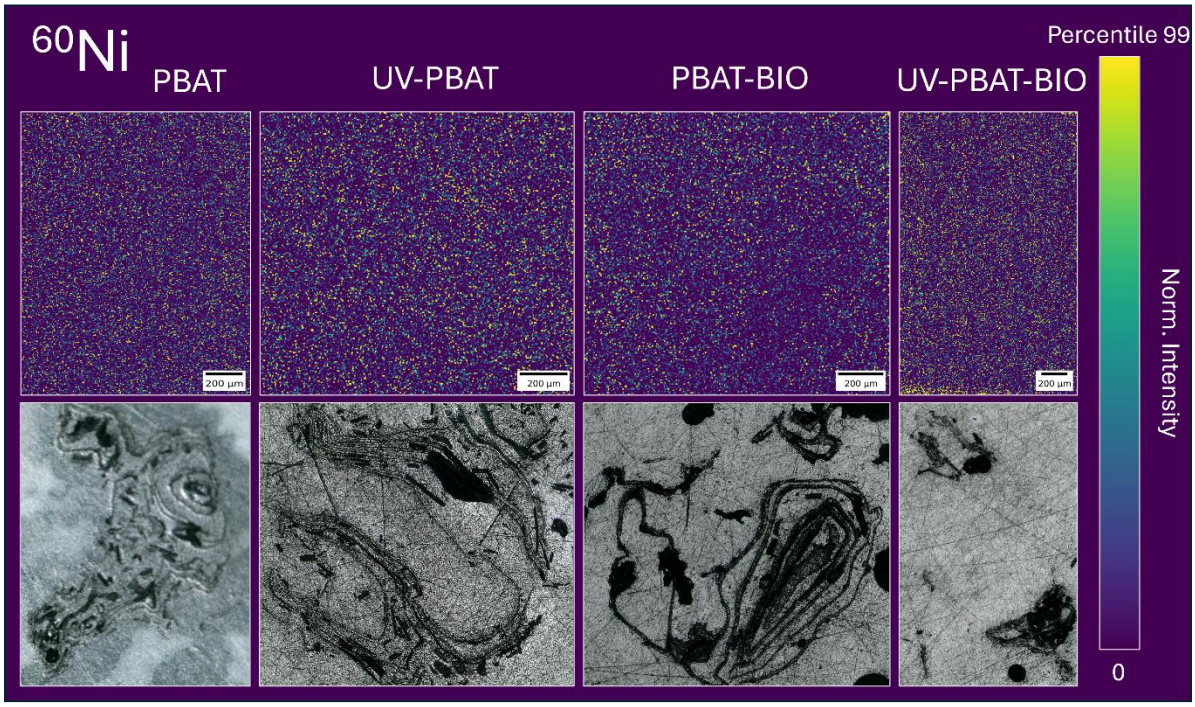

Figure S16. LA-ICP-MS analysis of Ni in pristine PBAT, UV irradiated (UV-PBAT) and after biodegradation (PBAT-BIO, UV-PBAT-BIO).

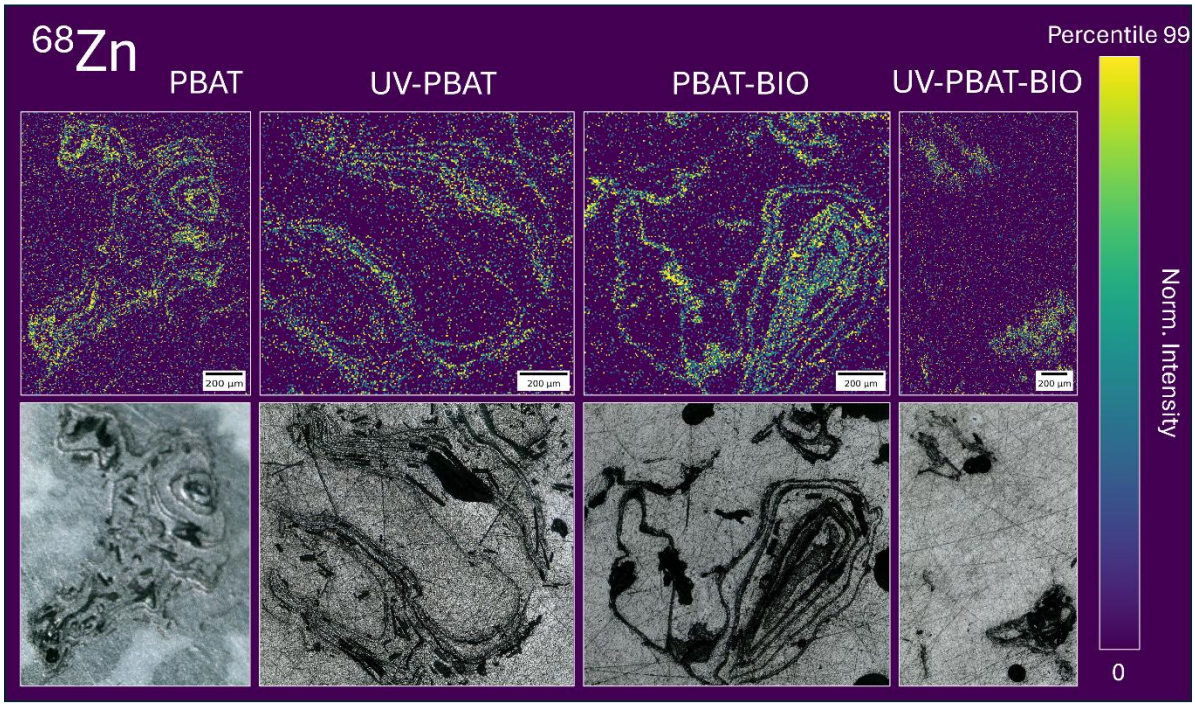

Figure S17. LA-ICP-MS analysis of Zn in pristine PBAT, UV irradiated (UV-PBAT) and after biodegradation (PBAT-BIO, UV-PBAT-BIO).

Table S5. *p* values of statistical analysis for analysis of crystallinity; comparisons between different treatments (one-way ANOVA, followed by the Tukey test).

Comparison	*p* (/)	Comparison	*p* (/)
PBAT – UV-PBAT	0.5037	PE – UV-PE	0.3990
PBAT – PBAT-BIO	**< 0.0001**	PE – PE-BIO	0.1192
UV-PBAT – PBAT-BIO	**< 0.0001**	UV-PE – PE-BIO	0.7948
PBAT – UV-PBAT-BIO	**0.0149**	PE – UV-PE-BIO	0.0578
UV-PBAT – UV-PBAT-BIO	**0.0029**	UV-PE – UV-PE-BIO	0.5142
PBAT-BIO – UV-PBAT-BIO	**0.0061**	PE-BIO – UV-PE-BIO	0.9535

Table S6. *p* values of statistical analysis for analysis of ecotoxicity experiment with *Lemna minor*; comparisons between different treatments (Kruskal-Wallis test, followed by Dunn's test).

	p (/)		
	Specific growth rate	Root length	Chlorophyll *a*
Control – PE	**0.0065**	**0.0037**	1.0000
Control – UV-PE	0.1005	**0.0418**	1.0000
Control – PE-BIO	1.0000	1.0000	1.0000
Control – UV-PE-BIO	1.0000	1.0000	1.0000
Control – PBAT	1.0000	1.0000	0.5531
Control – UV-PBAT	1.0000	0.8068	1.0000
Control – PBAT-BIO	1.0000	1.0000	1.0000
Control – UV-PBAT-BIO	1.0000	1.0000	1.0000
PE – UV-PE	1.0000	1.0000	1.0000
PE – PE-BIO	1.0000	1.0000	1.0000
PE – UV-PE-BIO	0.0946	**0.0378**	1.0000
UV-PE – PE-BIO	1.0000	1.0000	1.0000
UV-PE – UV-PE-BIO	0.0601	0.2093	1.0000
PE-BIO – UV-PE-BIO	1.0000	1.0000	1.0000
PBAT – UV-PBAT	1.0000	1.0000	1.0000
PBAT – PBAT-BIO	1.0000	1.0000	1.0000
PBAT – UV-PBAT-BIO	1.0000	1.0000	1.0000
UV-PBAT – PBAT-BIO	1.0000	1.0000	1.0000
UV-PBAT – UV-PBAT-BIO	1.0000	1.0000	1.0000
PBAT-BIO – UV-PBAT-BIO	1.0000	1.0000	1.0000